ENVIRONMENTAL AND SOCIAL IMPACT REPORT
BRAZIL
URUGUAIANA POWER PROJECT

BR-0257

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Private Sector Department

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[For IDB Public Information Center]

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I. INTRODUCTION

A. Need for Power

1.1 The long range planning for power supply conducted by the Comphania Estadual de Energia Electrica S.A. (CEEE - the electric distribution company for the State of Rio Grande do Sul) indicated that additional power sources will be required to support the expected growth in the State of Rio Grande do Sul, Brazil. It is estimated that at the current electricity consumption growth rates of five to seven percent per year, Brazil's installed capacity will increase three-fold by the year 2015. CEEE demand for industrial, commercial and residential power is growing at a rate of approximately five percent (130 MW) per year. CEEE currently imports 75 percent of its electricity via two 500 kV transmission lines. These transmission lines are routinely heavily loaded and cannot support future CEEE load growth. Further, little electricity generation exists in the western end of the CEEE distribution system, making the overall distribution system in this area weak and vulnerable to interruptions. The Uruguaiana project will provide generation at one of the weakest points of CEEE's distribution network and will greatly improve the quality and reliability of its service.

1.2 In response to its projected power needs, CEEE solicited bids for additional generating capacity. AES is a privately held corporation that develops, owns and operates power plants and is headquartered in Arlington, Virginia The power provided by the project will be used by CEEE to service Rio Grande do Sul's existing and future energy demands. In November 1996, CEEE issued a request for proposals (RFP) for the supply of electricity under a 20 year power purchase agreement. Both the choice of the fuel and a site within 12 km of the International Bridge were principal among CEEE's requirements in the RFP. Proposals were submitted on January 16, 1997. In March 1997, CEEE awarded AES Corporation the Uruguaiana Project, a 600-MW gas-fired facility located in Uruguaiana, Rio Grande do Sul, Brazil.

1.3 The Uruguaiana Project's gas-fired, combined cycle technology will bring much needed diversity and greater reliability to Brazil's electric power generating network. The country's electric generation system has an installed capacity of 57,500 MW of which approximately 93 percent is comprised of hydroelectric generation and 7 percent is comprised of thermal generation (i.e., coal, oil and nuclear). During low-water periods, hydroelectric generation decreases substantially, sometimes resulting in power supply deficits. Thermal generation is used to supplement the country's firm capacity during these periods. The Uruguaiana Project will contribute to the country's

pool of thermal generating capacity and improve the reliability of the electric power generating system.

B. Environmental Impact Study Issues

1.4 The Terms of Reference for the Environmental Impact Study (EIS) were issued by the Brazilian Institute for the Environment and Renewable Natural Resources on August 15, 1997. The EIS addresses the existing environmental conditions, potential project impacts and mitigation measures associated with the 44 hectare Uruguaiana Project plant site. The proposed project will include two new 230 kV electric transmission lines. However, an EIS is not required for electrical lines 230 kV or less as per CONAMA Resolution No. 001 of January 23, 1986, Article 1. A report that documented existing conditions along the proposed right-of way was submitted to FEPAM in December 1997. The major topics addressed in the EIS include the following:

- Project technical description.
- Existing environmental conditions.
- Project-related impacts.
- Site selection procedures.
- Project alternatives.
- Applicable legislation.
- Mitigation measures.

Following approval, construction is expected to begin in September 1998 with completion within twenty-four months.

II. PROJECT DESCRIPTION AND LOCATION

A. Project Description

2.1 The Uruguaiana Project includes the design, construction and operation of (1) a 600 MW combined-cycle thermal power plant fueled by natural gas; and (2) two electric transmission lines. The project is located in Uruguaiana in the State of Rio Grande de Sul, Brazil. The project site is about 44 hectares in size and is located in an area that is zoned for industrial developments. The site is bounded on the north by BR 472 (a paved two lane road), on the south by an active rail line and UR 204 (an unpaved dirt road), and on the east by largely undeveloped land. A basalt mine and stone crushing operation are located immediately across BR 472 from the site. Gas will be supplied by Petrobras which will purchase the gas from YPF in Argentina and deliver it to Sulgas, the local state gas distribution company. Sulgas will then sell the gas to the Uruguaiana Project. The construction of a 440-km gas pipeline will be required

to transport the gas from the field in Argentina to the Brazilian border. (Please see attached maps)

2.2 The project will sell 500 MW of firm capacity to CEEE under the terms of a 20-year power purchase agreement, for which CEEE will make capacity and energy payments.

B. Alternatives

2.3 A number of alternatives were considered in selecting the project's technology and location. Technological alternatives that were evaluated included the following:

- Natural gas-fired steam electric plant.
- Fluidized bed combustion steam electric plant.
- Pulverized coal combustion steam electric plant.
- Combined cycle.
- Integrated gasification/combined cycle.

2.4 The evaluation of each technological alternative considered economics, operation and maintenance requirements, and environmental and licensing factors. Performance factors were also considered such as heat rate, water consumption, pollutant emissions, solid waste generation, fuel flexibility, complexity and construction sequencing. For each criterion, the technologies were ranked from most advantageous to least advantageous. Overall, the combined cycle technology ranked highest due to its low unit heat rates, relatively low capital costs and negligible solid waste generation. Other advantages cited included short permitting and construction lead times, and low environmental impacts. The combined cycle configuration is also considered a mature technology with proven reliability and efficiency.

2.5 A site selection study was conducted in the early stages of project development to identify alternative sites. Principal among the requirements for the site was that it be located within 12 km of the International Bridge. Other specific criteria included the following.

- Size - Must be at least 10 acres in size.
- Land use compatibility - Existing and anticipated land uses on and adjacent to the sites were considered using area land use plans and/or master plans.
- Visual resources - Project's consistency with the type and extent of other developments in the area.
- Water supply - Facility will require 12,913 cubic meters per day or 0.15 cubic meters per second. Surface water resource evaluations were based on distance of a site from the Rio Uruguai. Groundwater resources would include withdrawal from the Botucatu Aquifer.

- **!** Transportation - Sites were evaluated based on their proximity to existing paved roadways and rail operations. Sites located outside municipal areas were more desirable because of the reduced potential for impacts to local traffic patterns.
- **!** Environmental features - Sites with unique environmental features such as unique habitat, significant cultural resources, and threatened or endangered species were excluded from consideration.

No environmental "fatal flaws" (e.g., surface water bodies; critical habitats; threatened/endangered species; historic/ archaeological sites; incompatible zoning designations, etc.) were identified for the project site during the site selection process.

2.6 Site E, the preferred site, is located in an industrial area that is already zoned for industrial use but not specifically for power plant development. The site is 12 km east of the International Bridge and 5 km north of the CEEE substation. Local roads and rail lines are available. The site is flat, undeveloped and covered by shrubs and grasses. Depth to ground water is about 150 to 200 m. Site E was selected as the preferred site because of its location within an industrial district, access to paved roads and railroad, and the potential for use of groundwater wells for water supply, thereby avoiding water pipeline construction. The proposed plant is consistent with current and planned developments. The plant site is located outside of town, thereby reducing construction-related traffic impacts.

C. Facility Characteristics

2.7 The Uruguaiana Project will utilize a gas-fired combined cycle process to generate electricity. The combined cycle power plant will burn natural gas in two state-of-the-art Westinghouse 501F combustion turbines to generate approximately 352 MW. Heat from the combustion turbines will be recovered in two heat recovery steam generators (HRSGs). Steam from the HRSGs will drive a single steam turbine to generate an additional 187 MW. Duct firing may be used in the HRSGs to generate additional steam and an additional 78 MW of electric power. Total maximum gross power output will be 617 MW and maximum net power output will be 600 MW.

2.8 If necessary, each combustion turbine can be operated in simple cycle mode with hot exhaust gases vented directly to the atmosphere through two 45.7-meter high HRSG bypass stacks. Two 30.5-meter high bypass stacks will be used during the four month period preceding completion of the HRSGs and initiation of the combined cycle operation.

2.9 Natural gas will be used as fuel under normal conditions. During periods of gas curtailment, oil may be burned as a back-up fuel. In such cases, water will be injected into the combustion chamber to control NO_x emissions.

D. Electrical Transmission

2.10 The Uruguaiana Project will include two new 230 kV electric transmission lines. The first electric transmission line will be about 5 km in length and will be constructed from the project site to the CEEE Uruguaiana substation located along route BR 290. The second electric transmission line will be approximately 130 km in length and will link the Uruguaiana Project to the substation located in Alegrete.

E. Fuel Supply

2.11 Petrobras will purchase gas from YPF's existing reserves in the Neuquen gas basin in Argentina. The gas will be transported from the reserves to the Argentina/Brazil border via the northern pipeline system of Transportadora de Gas del Norte S.A. (TGN), the Argentine gas transporter. A 440 km extension will be added to the system to complete the field-to-border delivery route. TGN has completed studies for the pipeline extension, has obtained 90% of the rights of way and has submitted the EIS for approval by the Argentine authorities. Approval for construction is expected in the second quarter of 1998. The pipeline extension is expected to take 12 months to complete. From the border, the gas will be delivered to the project by Sulgas, the local state gas distribution company. A 45.7 cm diameter pipe will be used for the pipeline extension. Amounts of up to 2,500,000 cubic meters per day will be delivered to the project. A new gas pipeline approximately 12 km in length will carry the gas from the International Bridge that connects Paso de los Libres, Argentina with Uruguaiana to the project site. This section of the pipeline is the responsibility of Sulgas and IBAMA/FEPAM will be responsible for the permitting of this pipeline. The proposed alignment will generally follow existing roadways. A preliminary alignment has been submitted to IBAMA/FEPAM. Documentation of existing conditions and potential impacts will be submitted

2.12 Distillate oil will be used in emergencies in which the natural gas supply is interrupted. The oil will be stored onsite in an aboveground tank with a 7,570 cubic meter capacity (adequate for up to 72 hours of operation). The tank will be located within a secondary containment dike for containing spills. According to the draft Plant Engineering, Procurement and Construction (EPC) Contract, dated December 1997, the oil storage capacity will increase to 11,900 cubic meter (adequate for up to 120 hours of operation. This will be a tank size change from one tank (7,570 cubic meters) to two tanks (6,000 cubic meters each).

F. Water Supply and Discharge

2.13 Water will be used for several functions including cooling, makeup, domestic use and general plant service. Water will be supplied by onsite groundwater wells. The total water withdrawal is estimated to be 12,913 cubic meters per day.

2.14 Based on the observed quality of the water withdrawn from the on-site well, except for chlorination and the addition of cooling tower water conditioning chemicals (scale inhibitors, corrosion inhibitors, biocide, etc.), pretreatment of raw water will not be required prior to use in facility cooling towers. Due to the elevated dissolved solids content of the groundwater, raw water will require treatment prior to use as cycle makeup water and NOx injection water (NOx injection used only when firing on distillate oil).

2.15 The cycle makeup treatment system will include pressure sand filtration, cartridge filtration, reverse osmosis, degasification , and mixed-bed ion exchange polishing. Wastestreams generated by this process will include sand filter backwash, reverse osmosis reject water, and ion exchange resin regeneration wastewater. Filter backwash will be combined with cooling tower blowdown in the cooling tower blowdown surge tank. Reverse osmosis reject water will be routed to the cooling tower basin for reuse. Ion exchange system regenerant wastewater will be routed to a waste neutralization tank prior to discharge to the wastewater storage basin.

2.16 Approximately 1,800 cubic meters per day of wastewater will be discharged via pipeline to the Rio Uruguai. The wastewater stream will consist largely of cooling tower system blowdown. Flows from plant drains, sumps and other oil-containing areas will be routed through an oil/water separator prior to discharge. Sanitary waste waters will be disposed of using an onsite subsurface sewage disposal (septic) system. Alternate means of sanitary disposal will be evaluated if site hydro geology precludes the use of an onsite septic system.

2.17 The use of Rio Uruguai for discharge of waters will include the construction of a discharge pipeline to the river. A shoreline discharge structure will also have to be built. The use of an onsite well or well field for water supply and associated pumping equipment will also have to be installed.

G. Proposed Schedule

2.18 Site preparation, equipment construction and installation, and initial operation at the Uruguaiana Project are scheduled to be completed in approximately 28 months. The first six months of site activities will be devoted to site clearing and grading and installation of systems to support the construction workforce. The next seven months will include equipment construction and installation, and additional civil engineering activities. After that time, mechanical work will begin and continue through the completion of construction.

2.19 Onsite construction will only begin following the issuance of the Installation License (LI). To date, the only activities conducted onsite have been related to obtaining data needed for facility design and in support of the environmental permitting process. No

site clearing, grading, or establishment of construction support facilities can take place until the LI is issued.

2.20 Per AES's contract, the Operating License (LO), and hence facility operation must begin 16 months after issuance of the "Installation License (LI)".

III. LEGAL AND REGULATORY FRAMEWORK

A. Regulatory Authority

3.1 Brazil has a solid legal and institutional framework for protection of its resources and for pollution control. The backbone of the Brazilian environmental policy is found in the 1988 Constitution and the 1981 National Environmental Policy Act (Law No. 6.938). Generally the federal responsibility for environmental protection is divided between two agencies: the National Environment Council (CONAMA) and the Brazilian Institute for the Environment & Renewable Natural Resources (IBAMA). Generally, CONAMA is responsible for drafting legislation and the basic guidelines for environmental protection and regulations for the preparation of environmental impact assessments and reports. IBAMA is responsible for enforcing the federal environmental protection laws.

3.2 In addition to the federal agencies, States and municipalities are authorized to enact and enforce their own environmental regulations. The environmental agency for the state of Rio Grande do Sul is the State Foundation for the Protection of the Environment (FEPAM). Although the state would typically oversee the EIS process and issue the permits for this type of project, IBAMA asserted its authority over the project because it is considered to potentially have significant regional and national environmental impacts (primarily associated with the proximity to the international border). Accordingly, the project permitting process and EIS process will be controlled by IBAMA with input from FEPAM.

B. Laws, Regulations, and Guidelines Applicable to the Project.

3.3 The Project is subject to a broad spectrum of environmental laws, regulations, and guidelines, including both Brazilian regulatory requirements as well as the 1997 World Bank Thermal Power Guidelines for New Plants.

3.4 Table 1 provides a summary of the Brazilian environmental laws and regulations reviewed for applicability to the project in preparation of the EIS. These laws and regulations address the following issues: environmental impact assessment, air emissions, water resource use and wastewater discharge, noise emissions, combustible and flammable liquid storage, and solid and hazardous waste generation and disposal. The proposed project will comply with the substantive and procedural requirements of these Brazilian laws deemed applicable to the Uruguaiana Plant.

3.5 The World Bank Thermal Power Guidelines for New Plants, issued September 1, 1997, will also apply to the project. Tables 2a through 2d provide a summary comparison of the World Bank guidelines and the Brazilian regulatory standards for air emissions, ambient air quality, liquid effluent (wastewater), and noise.

C. Environmental Impact Assessment and Permitting Process

3.6 Under CONAMA's Resolution No. 1 issued January 23, 1986, an environmental impact assessment (EIA) and subsequent environmental impact report (RIMA) (essentially a summary of the EIA) are required for development of a primary energy source with a capacity in excess of 10 MW and electric transmission lines with capacities exceeding 230 kV. Because the Project transmission line will not exceed 230 kV, an EIA for the transmission line portion of the project is not required (see section III.D for details on environment requirements).

3.7 Decree No. 99.274 issued June 6, 1990 requires issuance of a Preliminary License (LP), Installation License (LI), and Operating License (LO) for the respective stages of planning, construction, and operation of the facility.

3.8 The permitting process begins by establishment of the Terms of Reference (TOR) for the EIA and RIMA by IBAMA (for this project). The TOR essentially outlines the issues which must be addressed and the content requirements for the EIA.. Once the EIA and RIMA have been prepared and submitted, IBAMA publishes a public notice of the project in the state and local municipality. A public hearing can be held no sooner than 45 days after filing of the EIA and RIMA with IBAMA. The public hearing is managed by the Project Sponsor with IBAMA representatives attending as observers and provides an opportunity for the local population to express comments or concerns.

3.9 IBAMA will issue the LP upon conclusion of the public hearing and completion of the interdisciplinary review of the EIA and RIMA. The LP will identify environmental issues which must be resolved prior to issuance of the LI.

3.10 IBAMA will issue the LI once the applicant has resolved the environmental issues identified in the LP to the satisfaction of IBAMA. The LI will establish the construction related monitoring and mitigation requirements and will provide the foundation for the LO.

D. Transmission Line Permitting

3.11 Permits for installation of the transmission lines will be issued by FEPAM. Since the transmission lines are below the threshold capacity of 230 kV as established in Brazilian law (CONAMA Resolution No. 001 of January 23, 1986, Article 1), it is not necessary to prepare an EIA/RIMA or conduct a public hearing to obtain official approval of the transmission line from FEPAM.

3.12 AES submitted to FEPAM on December 4, 1997, a report that documented the environmental conditions along the alignment proposed for the electrical transmission lines. The alignment is generally within 60 meters of the existing CEEE transmission

lines. The area that will be traversed is generally open grassland that is used for grazing cattle. Design of the towers will adhere to specifications provided by CEEE and construction and installation will follow generally accepted procedures. The total area of disturbance will be minimal and no significant impacts have been identified that would require use of special mitigation measures.

3.13 Upon receipt of the remaining portions of the application (summary of the property uses along the transmission corridor and an approved project description (description must be prepared by an electrical engineer), FEPAM anticipates issuance of the permit required for commencement of transmission line construction.

E. Gas Pipeline Permitting

3.14 Construction of the short section of gas pipeline in Brazil will require the development of an EIS and RIMA. Consultation with IBAMA suggests that there are few environmental concerns and the permitting should be relatively simple.

3.15 Construction of the gas pipeline in Argentina is regulated by the federal Secretary of Energy, and will require preparation and submission of an Environmental Impact Study for review and approval. The project company is TGN and the environmental regulators for this project are Ente Nacional Regulador del Gas (ENARGAS) and the Provinces where the pipeline is located.

F. Compliance\Licensing Status

3.16 The EIA and RIMA for the proposed project were submitted to IBAMA on December 15, 1997. The formal public notice was published in a local Uruguaiana newspaper on January 9, 1998. A public hearing was held on February 6, 1998 at the Uruguaiana municipal offices. Formal presentations by project sponsors and their environmental consultants were made, followed by submittal and responses to written comments from those in attendance. The limited questions were related to air pollutant dispersion modeling, specification of receiving waters for wastewater discharges, identification of effluent treatment processes, water supply source, and monitoring issues. All of these issues were responded to verbally by project sponsor representatives at the hearing. IBAMA has provided comments on the EIS and RIMA to the project sponsors.

3.17 Although an EIS review is not required for the transmission line, AES has prepared and submitted to FEPAM on December 4, 1997 a report that documented environmental conditions along the transmission line route. AES noted that the alignment is generally within 60 meters of existing CEEE transmission lines, and mostly transverses open grassland that is used for grazing cattle. Accordingly, the total area of disturbance will be minimal and there are no significant impacts identified that will require use of special mitigation measures.

3.18 AES has developed an outline of an Environmental and Social Management Plan for monitoring and managing environmental compliance and implementation of mitigation measures during construction and operation of the plant. A summary of this Environmental and Social Management Plan is included in Section VI.

3.19 As part of the baseline studies that were conducted for the EIS, a Phase I Environmental Assessment Report was prepared for the project site. No onsite contamination was found as a result of previous onsite activities or activities of adjacent land owners.

3.20 The EIS for the Argentina portion of the gas pipeline has been completed by TGN (April 9, 1997). The EIS included an executive summary of the pipeline project, alternative route analysis, existing environmental conditions, identification and evaluation of impacts, and mitigation and monitoring plans. The final EIS has been submitted for review to the regulatory agencies and TGN expects the review to be completed by March to April 1998.

IV. SOCIAL AND ENVIRONMENTAL BACKGROUND INFORMATION

A. Physical Environment

4.1 Climate and Meteorological Conditions: The climate of the region is humid subtropical with hot summers and mild winters. Average monthly temperatures are 23 to 27°C in summer and 14 to 15.5°C in winter. There is no dry season, and the driest month in winter receives 71.1 mm of rainfall. Annual average wind speeds are 3.8 m/sec with the highest wind speeds (4.6 m/sec) in spring and lowest wind speeds (2.7 m/sec) in autumn. Prevailing winds are from the east during summer and autumn, and from the northeast during winter and spring.

4.2 Existing Air Quality: The only significant sources of air pollutants in the site area are a basalt quarry and asphalt plant both located across from the site on the north side of BR 472. The quarry operation is a source of fugitive dust; the asphalt operation is a source of dust and sulfur dioxide (SO_2).

4.3 To identify onsite ambient air quality conditions, AES Brasil established a pollutant monitoring program at the CEEE substation 5 km south of the proposed project site from October through December 1997 for total suspended particulates (TSP) and from October 1997 through January 1998 for SO_2, nitrogen oxides (NO_x), and nitrogen dioxide (NO_2).

4.4 The average TSP concentration from October through December 1997 was 12.5 $\mu g/m^3$; the maximum concentration was 35.9 $\mu g/m^3$ on December 6, and the minimum was 2.0 $\mu g/m^3$ on December 30. These concentrations are well below Brazilian Ambient Standards and World Bank Guidelines (Table 2b).

4.5 The ambient air quality concentrations for SO, NO_x, and NO_2 are shown below. These concentrations are also well below Brazilian Ambient Standards and World Bank Guidelines (Table 2b).

TABLE 4.5-1

Monitored Background Concentrations (ug/m3)
CEE Substation October, 1997 - January, 1998

Pollutant	Averaging Period	October, 1997	November, 1997	December, 1997	January, 1998
SO_2	Month	10	16	18	21
	Highest 24-hour	21	29	34	47
	HIghest 1-hour	31	52	55	66
	Lowest 1-hour	8	8	8	8
NO_x	Month	6	6	6	4
	Highest 1-hour	120	66	88	55
	Lowest 1-hour	4	4	4	4
NO_2	Month	4	4	4	4
	Highest 1-hour	56	23	62	11
	Lowest 1-hour	4	4	4	4

Conversion factors: ug/m^3 = (ppm x molecular weight)/24.45
Molecular weight SO_2 = 64.07; NO_x = 46.01; NO_2 = 46.01
ex: 5 ppm SO_2 = (5 x 64.07)/24.45 = 13.1 ug/m^3

4.6 Noise: An ambient noise study was performed over a two-day period in September 1997. The major noise sources near the project site during the monitoring period were the two roadways, the railroad, and the gravel screening/asphalt operation. The CAUL rice plant did not contribute to the noise environment during the monitoring period. During the daytime, noise levels averaged 53 dBA; during the nighttime, sound levels averaged 48 dBA.

4.7 Geology and Geomorphology: The project site is located in the Parana Province, corresponding to the Sedimentary Basin of Parana, which closely coincides with the Meridional High Plains. The project site is situated in a section of these plains known as the Planalto de Uruguaiana. Bedrock formation in the plains is basalt overlying sandstone formation known as the Botucatu.

4.8 The presence of interbedded layers of basalt flows and sandstone to a depth of approximately 156 m are present at the project site. The interbedded sandstone layers range in thickness from 4 to 20 m; the basalt layers range in thickness from 12 to 104 m. Basalt flows extend to depths ranging from 50 to 200 m, below which is an extensive sandstone formation containing the confined Botucatu Aquifer, which has a thickness of approximately 100 m.

4.9 Soils: Soils are composed of silty clays and silty sands, with a fraction of basaltic rock fragments down to an average depth of 2 m. These soils overlay a fractured layer of basalt rock whose competency increases with depth. The soils in this region are classified as having low potential for agricultural use due to basalt rock fragments of less than 0.5 m in diameter that are frequently exposed at the surface.

4.10 Topography: The topography can be described as flat to undulating, reflecting the topography characteristic of the Uruguaiana Region. The central portion of the project site sits atop a slight topographic high relative to the remainder of the site and to the immediate surrounding area. Surface drainage evenly divides into a west and east flow patterns. The slightly elevated terrain separates the Arroio do Salso watershed to the west from the Arroio do Imbaa watershed to the east. The site slopes gradually downhill in a southwest direction.

4.11 Water Resources: The project site is located within the Rio Uruguai drainage basin at an approximate elevation of 90 m. The Rio Uruguai, located approximately 10 km west of the project site, forms the border between Brazil and Argentina. Lowest river flows are observed from January through March and highest flows are observed from August through October. The lowest reported daily flow was 403 cubic meters per second (m^3/s) in January 1953; the highest reported daily flow was 32,168 m^3/s in July 1983. The average daily flow for the period of record is 4,504 m^3/s. The project site is higher than the surrounding area and is not subject to flooding.

4.12 The project site contains no rivers, lakes, steams, or wetlands. The project site is located between two brooks, the Arroio do Imbaa and the Arroio do Salso de Cima. The Arroio do Imbaa, located approximately 1 km east of the project site, discharges to the Rio Uruguai 7 km upstream of the International Bridge. The Arroio do Salso de Cima, located 1.3 km to the south of the project site, discharges to the Rio

Uruguai 1 km upstream from the International Bridge. No historic streamflow data are available for either arroio.

4.13 Groundwater will serve as the water supply for the proposed power plant. Groundwater will be withdrawn from the underlying "Botucatu" sandstone aquifer using 3 to 4 wells with screened interval depths in the range of approximately 150 to 250 meters below the ground surface. Based on well logs for the first water supply well installed onsite, local stratigraphy consists of approximately 3 meters of topsoil overlying a 153 meter basalt formation containing intertrapped layers of sandstone (referred to as the Serra Geral formation), which in turn, overlies the Botucatu sandstone aquifer. Although lesser quantities of water can be withdrawn from the Serra Geral's intertrapped sandstone layers, the continuous Botucatu aquifer will best serve as the productive water supply for the project.

4.14 The Botucatu Aquifer is a confined aquifer, as was demonstrated by an observed 43 m rise in a static head upon penetration of the sandstone unit. The exact thickness of the aquifer in the vicinity of the project is not known. It is at least 100 meters thick and, based on regional data, its thickness could exceed 200 meters. The aquifer's approximate 9,000 km^2 recharge area is a sandstone outcrop area located several hundred kilometers east of the project site. Based on the assumption that approximately 16 percent of the 1,400 mm annual precipitation rate infiltrates the aquifer, it has been estimated that the aquifer's annual recharge rate is approximately 1.89×10^9 m^3 per year.

4.15 Groundwater in the vicinity of the project site is used for drinking water, irrigation, and as a water supply for livestock. Preliminary studies have indicated six users of the Botucatu Aquifer within an 8 km radius of the project site. These six privately owned wells are located on properties directly to the east and west of the project site. The wells are screened within the top 40 to 70 m of the Botucatu sandstone formation and have production rates of 100 to 190 m^3/hr. CORSAN, the City of Uruguaiana's local water supplier, also operates four small wells at distances of 6 to 10 km from the project site. These wells are believed to be screened in the upper 10 meters of the Botucatu Aquifer and yield approximately 30 m^3/hr. The newly installed on-site well penetrated more than 100 meters into the Botucatu aquifer. Results of a pump test conducted using the new well, supplemented by known pumping rates of other area wells screened in the Botucatu aquifer, confirm that well pumping rates of 200 m^3/hour can be achieved in wells screened in the Botucatu aquifer unit.

4.16 Sampling of groundwater withdrawn from the newly installed onsite well was performed in December 1997. Results of the analyses of shallow groundwater samples indicate that the groundwater quality is good and below limits set by Regulation 36 of the Ministry of Health, 1/19/90. No evidence of historic

contamination exists onsite. A second phase of groundwater studies will be performed for the purpose of locating the wells that would be used to support plant operations.

4.17 The Rio Uruguai serves as a recreational source and as the potable water source (30,000 to 36,000 m^3/d) for the City of Uruguaiana. Sanitary wastewater from the city, primarily untreated, is returned to the river by way of the Arroio do Salso de Cima. The river is not used for navigation, commercial fishing, or aquaculture.

4.18 In accordance with Brazilian Resolution No. 20 of June 18, 1986 which established water quality limits, the Rio Uruguai is considered a Brazilian Class 2 water body. The categorization of water bodies is based on the water quality levels required to meet the needs of the community, and not necessarily the current quality of the water. Class 2 waters are intended for domestic use after conventional treatment, protection of aquatic communities, primary contact recreation, irrigation of vegetables and fruit-bearing plants, and natural and/or intensive production (aquaculture) of species intended for human consumption. The water quality of the Rio Uruguai is within applicable Brazilian Class 2 water quality criteria for most parameters. However, fecal coliforms (0 to 280,000/100 ml) and total coliforms (24,000 to 240,000/100ml), dissolved oxygen (4.6 to 10.0 mg/l), total phosphate (0.15 to 0.38 mg/l), mercury (ND to 0.0005 mg/l), and phenols index (ND to 0.023 mg/l) concentrations exceed the applicable Brazilian Class 2 water quality criteria. Brazilian Class 2 water quality criteria for these parameters are: fecal coliforms (1,000/100 ml) and total coliforms (5,000/100ml), dissolved oxygen (>5 mg/l), total phosphate (0.025 mg/l), mercury (0.0002 mg/l), and phenols index (0.001 mg/l).

B. Biotic Environment

4.19 Terrestrial Ecosystems: The natural vegetation in the region is described as a steppe or shrub grasslands. The project site is located in an agricultural grazing ecosystem composed of grass and shrubs. The project site is not located within any specially protected area or within a 10-km radius of any such area. No streams, wetlands, or other aquatic habitats are located at the project site. During site inspections by AES environmental subcontractors, no specially protected plants were identified. Seventeen mammalian species and 73 bird species were observed at the site. None of the observed species are listed as threatened or endangered species. The closest wetlands are associated with the Arroio do Imbaa located approximately 1 km east of the project site. Because effluents will be discharged to the Rio Uruguai, these wetlands will not be affected by the project.

4.20 Aquatic Ecosystems: Sponges are abundant in the Rio Uruguai. More than 140 species of fish have been identified from the river. Characiforms and siluroids are the

dominant fish taxa. Fourteen species of fishes have been collected from the Arroio do Salso Cima. Fish species included characins, perches, and catfishes.

C. Socio-Economic Environment

4.21 Uruguaiana is located in an agrarian region, economically dependent on cattle ranching and to a lesser extent on agriculture. The region is currently undergoing transition brought about by general commercialization and industrial development in Brazil. As of 1991, 93 percent of Uruguaianans are able to read and write. Per capita income was US $4,074 in 1994. Currently, about 90 percent of Uruguaianans live in urbanized areas.

4.22 Population: The proposed project site is approximately 3 km east of the urban limit of the City of Uruguaiana in an industrially zoned area. The industrial zone is currently undeveloped; nearby industrial activities include a rice processing cooperative, a stone quarry, an asphalt plant, and a meat processing facility. A few small residences (brick homes to makeshift shacks) with limited vegetable cultivation and animal husbandry (cattle, horses, and fowl) are present on lands adjacent to the project site. The immediate surrounding area is occupied by cattle ranches. The village of Charqueada and a cluster of 12 rural residences are within 1 km of the project site. A rural grade school serving 139 students is 800 m east of the project site. The school serves the educational and social needs of the population within 20 km of the school. Approximately 200 residents live in the immediate vicinity of the proposed facility.

4.23 Economic Base: Uruguaiana serves as the trading center between Brazil, Argentina, and Uruguay, a role enhanced by MERCOSUL, the South American Trade Agreement. In September 1997, $329 million dollars of exported goods crossed the International Bridge from Brazil into Argentina; $180 million dollars of imported goods crossed the bridge from Argentina into Brazil. The total movement in both directions represented a 14 percent increase from 1996. Between 1985 and 1995, traffic on the bridge increased more than 300 percent. Approximately 600 trucks per day pass through Uruguaiana's shipping center, Porto Seco do Brasil. The trucks represent 35 percent of the commercial transport of MERCOSUL and 60 percent of the total value of goods.

4.24 In addition to Uruguaiana's role as a transportation center, strong agriculture and cattle ranching exist outside the city and throughout the pampa region that extends beyond the international boundary of the Rio Uruguai.

4.25 Transportation/Traffic: Because of the increased trade through Uruguaiana, there has been a significant increase in the volume of commercial trade using the roadways.

Annual truck traffic has increased from approximately 28,800 in 1985 to 139,775 in 1996. The city appears to be effectively managing the increased traffic volume and the processing of import and export required in transboundary trade. However, traffic congestion during peak traveling hours has become a problem.

4.26 Most "interstate" roads leading to Uruguaiana, including BR 472 which connects the project site to the city, need significant repairs or upgrades. Traffic accidents, including fatal car crashes and pedestrian fatalities, are common along BR 472. Plans have been announced to rebuild BR 472. Public transportation is limited to the urban area. Residents outside the city use cars, trucks, and horses. The rail terminal serving the Uruguaiana area is located in Hipica on the eastern edge of the urban area. Over the next four years the railway system of the region will be updated.

4.27 Employment/Skill Labor Force: Uruguaiana's labor force is primarily employed in the service sector. Next in importance is the industrial sector followed closely by the agriculture sector. Unemployment in Uruguaiana as well as the entire Rio Grande do Sul is significant. In 1990, statewide unemployment was approximately 47 percent. Most of the 150 inhabitants of the nearby village of Charqueada are employed at the rice processing cooperative and the stone crushing asphalt plant.

4.28 As of 1991, only 16 percent of Uruguaianans had a formal education past the secondary level. Uruguaiana has a state-sponsored free, public school system offering primary through secondary education as well as private and public universities. The Pontifica Universidade Catolica de Rio Grande do Sul has about 1,400 students and offers 15 specialties. Uruguaiana also has a technical/vocational institute.

V. POTENTIAL IMPACTS

5.1 The following sections discuss potential construction (5.1) and operation (5.2) environmental and social impacts from the proposed power project.

A. Construction Impacts

5.2 Air Quality: Air pollutant emissions will consist of fugitive particulates that result from earthwork and vehicle traffic and wind erosion of exposed surfaces; emissions from operation of vehicles, heavy equipment, and other internal combustion engine-powered equipment; and emissions of volatile organic compounds from paint solvents, cleaning solvents, and asphalt paving operations.

5.3 Noise: Noise will vary according to the particular phase of construction. Based on modeling results provided in the EIS, noise will only exceed ambient sound levels during the first construction phase, ground clearing, and will be short term.

5.4 Geology and Geomorphology: General impacts will include the removal of unconsolidated rock and earth in proposed excavation sites.

5.5 Soils: Impacts to soils could include loss of excavated soil due to water and wind erosion, reduction of soil quality from mixing topsoil with subsoil, and soil compaction caused by frequent passage of construction equipment. Soil erosion is expected to be minor, due to the relatively flat topography. Due to the shallow depth to overburden groundwater (0.5 to 1.5 m), dewatering may be required. Natural drainage patterns may be temporarily altered by frequent passage of heavy equipment.

5.6 Topography: No significant changes in existing contours will occur from construction. If necessary, soil may be used for additional construction and grading purposes.

5.7 Water Resources: The potential for the contamination of surface waters is diminished because no significant surface waters are present onsite. Storm water runoff from the site will follow natural drainage patterns before discharging to either the Arroio do Imbaa or the Arroio do Salso de Cima. These surface waters could be affected by discharges of sediment laden and/or potentially contaminated storm water runoff, construction dewatering discharges, and by sanitary waste discharges. However, all storm water discharges from the project are not expected to significantly affect the receiving waters.

5.8 Construction-related groundwater impacts are not expected to be significant. Groundwater could be impacted by potential infiltration of sanitary wastewater

discharges or by spills of construction-related chemicals. Effluent from the construction phase sanitary treatment system will be discharged offsite via an existing drainage ditch. Some portion of the effluent could infiltrate the ground surface, potentially encountering the shallow groundwater table.

5.9 Biological Resources: The project site and its vicinity are not inhabited by significant or diverse plant or animal communities. Construction will result in the removal of vegetation in the construction area. Although there is potential for displacement of some animal species, the minimal vegetative cover and lack of significant surface water resources onsite as well as the limited species number and diversity onsite, will minimize the potential impact on animals. Construction will temporarily increase ambient sound levels and will result in temporary localized air quality impacts due to dust and vehicle emissions. Storm water from construction activities may contain pollutants that when discharged to receiving waters may impact aquatic organisms.

5.10 Socio-Economic Conditions: Project construction will benefit local socioeconomic conditions by providing jobs and contributing revenues through project-related expenditures. The estimated number of construction workers on the project at one time will peak at 513. Approximately 30 percent of this total will come from the local area and the remainder will come from outside areas. Efforts are being made to maximize the use of local labor and reduce the need to relocate labor from outside the area.

5.11 Technical professionals from outside the area are expected to utilize available rental housing in Uruguaiana. Skilled workers from outside the area will utilize temporary housing provided by the construction contractor. The temporary housing will be located outside the Uruguaiana urban zone, within about 2 km of the project site and away from existing settlements. The housing complex will be designed to include sanitary facilities, recreation areas, cooking facilities and food services. Workers will be transported to the site by bus.

5.12 Overall, the influx of outside workers is expected to benefit the local economy. The presence of technical professionals will contribute to the economy through housing rental, food purchases, and entertainment expenditures. Such professionals are typically law-abiding and would not be expected to contribute to local crime rates. Other outside labor forces will be concentrated in the temporary housing complex and are not likely to negatively affect local communities. No human populations will need resettlement.

5.13 Local schools are not expected to be impacted by project construction because most workers will be temporary and will probably not bring their families with them. Routine medical services and treatment for minor injuries will be provided at the work

site and at the temporary housing complex. Local hospitals appear to have sufficient capacity to handle more serious emergencies and medical needs. No temporary or permanent deactivation and/or relocation of existing utilities will be required.

5.14 Project construction is not expected to significantly impact aesthetic conditions. Industrial silos and conveyor systems exist nearby and are similar in size to the project stacks. Visual impacts will be minimized through the use of landscaping design.

5.15 The development of the site for a power generation facility is not incompatible with surrounding land uses. The project will be well-buffered from adjacent uses and the aesthetic conditions will be consistent with the industrial zone where the project site is located. Therefore, the proposed project will not adversely impact current or planned land uses.

5.16 Public Health: The increase in traffic, emissions from construction activities, and an influx of workers may affect public health. Construction related traffic (estimated to peak at 50 trucks per day) will result in increases in local noise levels and air pollutant emissions such as fugitive dust and carbon monoxide. Dust control and air pollutant control measures will be implemented to reduce air quality impacts, particularly in local residential areas. Work activities will be limited to daylight hours to minimize noise disturbances during normally quiet hours.

5.17 Historical, Cultural and Archaeological Heritage Sites: No sites of historical, cultural, or archaeological significance have been identified at the project site or in the project area. In addition, no areas designated as Indian Territories are located in the region. Therefore, the project will not impact any historical, cultural, or archaeological site or Indian Territory.

B. Operational Impacts

5.18 Air Quality: Use of natural gas will minimize air pollutant emissions. However, carbon monoxide (CO), nitrogen oxides (NO_x), and particulate matter (PM) will be emitted from two heat recovery steam generator (HRSG) stacks, as a result of natural gas combustion in the turbines. Carbon monoxide is formed as a result of incomplete combustion of fuel. Limiting the formation of CO is accomplished by providing adequate fuel residence time and high temperature in the combustion turbines to ensure complete combustion. Small amounts of particulates will also be emitted from the closed cycle cooling tower which is used to condense steam produced in the HRSG. The onsite oil storage tank will emit volatile organic compounds (VOC) at a rate of 1 to 2 tons per year. VOCs result from the incomplete combustion of organic constituents in the fuel as well as from the formation of other compounds.

The amount of VOCs produced is a function of oxygen availability (excess air), flame temperature, equipment design and turbulence.

5.19 Dispersion modeling was conducted using the US EPA's Industrial Source Complex Model (ISCST3, Version 96113) to calculate the maximum impacts of SO_2, NO_x, PM, and PM_{10} emissions from the proposed power plant. ISCST3 was initially employed in a screening mode using worst case meteorological conditions to model various load and ambient temperature scenarios to identify the worst-case operating scenario which produces highest ground-level ambient pollutant concentrations.

5.20 Based on the screening level air quality modeling results, total concentrations of NO_2, SO_2, PM, and PM_{10} from the facility will be well below both Brazilian and World Bank ambient air quality limits (Table 2b). The estimated air quality concentrations for each constituent (including background concentrations plus project-related pollutant concentrations) are shown below.

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Resolution No. 1 (January 23, 1986)	Requires the completion of an environmental impact study (EIS) and subsequent environmental impact report (RIMA) for many activities, including any primary energy source with a capacity in excess of 10 MW and electric power lines with capacities exceeding 230 kV. Provides a scope for the RIMA.
Federal Decree No. 84.017	Created conservation areas denoted as Parks which are currently designated as Conservation Units.
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TABLE 5.20-1

Maximum Air Quality Impacts From the Project (ug/m^3)

Pollutant	Averaging Period	Background Concentration	Estimated Plant Impact	Estimated Total Impact
NO_2	Annual	5.3	3.0	8.3
	Maximum 24-hour average	8.3	25.0	33.3
	Maximum 1-hour average	27.8	132.6	160.4
SO_2	Annual (nat. gas)	10.8	0.02	10.8
	Maximum 24-hour	21.8	11.5	33.3

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Pollutant	Averaging Period	Background Concentration	Estimated Plant Impact	Estimated Total Impact
	average (No. 2 oil)			
Total PM	Annual (nat. gas)	15.2	0.2	15.4
	Maximum 24-hr average (No. 2 oil)	34.9	11.2	46.1
PM_{10}	Annual (nat. gas)	15.2	0.2	15.4
	Maximum 24-hr average (No. 2 oil)	34.9	8.1	43.0

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5.21 The height of the stack plus the accompanying plume rise will allow enough time and distance for dispersion of the emissions with the result that downwind ground-level concentrations will be well below Brazil and World Bank ambient air quality standards. Emissions will have little or no effect upon surrounding soils, vegetation, croplands or livestock, or on area-wide ozone concentrations.

5.22 The project design for the plant includes the potential to run on distillate fuel during limited time periods due to unavailability of gas. The project sponsor has committed to use a quality distillate fuel that will ensure that the proposed power plant's PM emissions will be at or below the World Bank PM emission limit of 50 mg/Nm^3 at 15 percent O_2 while on distillate oil.

5.23 For the 15 days when gas is not available, the facility will undergo routine, annual maintenance. For the 30-day period when gas supply is restricted, the facility will run at a reduced level. Should gas supply be affected during this period, oil will only be used to achieve the reduced operating level that would have otherwise been maintained with the restricted gas supply.

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5.24 Noise: Based on noise modeling results provided in the EIS, the operation of the facility will not exceed Brazilian standards (70 dBA and 65 dBA for residences in industrial zoned areas) and World Bank guidelines (70 dBA at the property line of new thermal power plants) (Table 2d). Noise modeling showed that during project operation, noise levels at the northeast and southeast corners of the site would reach 60 dBA and 64 dBA, respectively. The modeling also showed that noise levels at the eastern boundary of the industrial park would reach 55 dBA.

5.25 The one residence located north of the project site and south of the stone crushing/asphalt facility has been purchased by the developer as part of the land acquisition for the project. The exposure levels at the closest offsite receptor, the elementary school located east of the industrial zone, will not exceed Brazilian limits for urban residential areas.

5.26 Geology and Geomorphology: No discernible impacts to geologic resources are expected during operation.

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5.27 Soils: Soils may be affected by storm water runoff from impervious surfaces and other structural features which collect and concentrate rainwater.

5.28 Topography: No operational impacts to the topography are anticipated.

5.29 Water Resources: Impacts will be due to water withdrawal from the groundwater, the treatment and use of that water, and the discharge of wastewater and storm water from the site. Based on current information, the Botocatu Aquifer has a potential yield of 28.6 million m^3/year of water (78,356 m^3/day). The plant's water withdrawal of 12,913 m^3/day should not significantly affect the aquifer's water levels or existing uses.

5.30 Discharge to the Rio Uruguai should have no impact on the river's water quality because the wastewater that is returned will meet the applicable effluent limits. Approximately 1,800 m^3/day of process wastewater (consisting of cooling tower blowdown, evaporative cooler blowdown, HRSG blowdown, demineralizer system

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regenerant wastewater, and miscellaneous plant drains) will be discharged from the power plant. The wastewater will be treated prior to discharge to ensure that the effluent characteristics comply with Brazilian effluent limits and World Bank guidelines (Table 2c). Discharges from plant drains and from oil storage tank containment areas will be routed through an oil/water separator prior to discharge. The final design of the treatment systems will be determined based on the anticipated quality of the water supply, the operational requirements of the cooling tower and HRSG systems, and the applicable effluent limits.

5.31 Discharge to the Rio Uruguai should have no impact on the river's water quality because the wastewater that is returned will meet the applicable effluent limits. Approximately 1,800 m^3/day of process wastewater (consisting of cooling tower blowdown, evaporative cooler blowdown, HRSG blowdown, demineralizer system regenerant wastewater, and miscellaneous plant drains) will be discharged from the power plant. The wastewater will be treated prior to discharge to ensure that the effluent characteristics comply with Brazilian effluent limits and World Bank guidelines (Table 2c). Discharges from plant drains and from oil storage tank

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containment areas will be routed through an oil/water separator prior to discharge. The final design of the treatment systems will be determined based on the anticipated quality of the water supply, the operational requirements of the cooling tower and HRSG systems, and the applicable effluent limits.

5.32 Storm water runoff will be produced during precipitation events but because of the implementation of several storm water control measures, should not significantly affect local surface waters. The project will include a storm drainage system to control peak discharges of storm water runoff and to minimize local erosion. Discharge to the Rio Uruguai should have no impact on the river's water quality because the wastewater that is returned will meet the applicable effluent limits. Approximately 1,800 m^3/day of process wastewater (consisting of cooling tower blowdown, evaporative cooler blowdown, HRSG blowdown, demineralizer system regenerant wastewater, and miscellaneous plant drains) will be discharged from the power plant. The wastewater will be treated prior to discharge to ensure that the effluent characteristics comply with Brazilian effluent limits and World Bank guidelines (Table 2c). Discharges from plant drains and from oil storage tank

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containment areas will be routed through an oil/water separator prior to discharge. The final design of the treatment systems will be determined based on the anticipated quality of the water supply, the operational requirements of the cooling tower and HRSG systems, and the applicable effluent limits.storm water detention basins. Drainage from facility oil storage areas will be routed to an oil/water separator prior to offsite discharge. The establishment of vegetation in denuded areas will be used to control erosion, and chemical and oil storage practices will be used to reduce the potential exposure of these materials to site Storm water.

5.33 Biological Resources: Although native vegetation will be affected by construction, the site will be landscaped following construction. Operation of the facility will not reduce the current value of the site for wildlife habitat. Wastewater discharge impacts to aquatic species will not be significant.

5.34 Socio-Economic Conditions: Operation of the facility will require approximately 50 employees. This number of workers is not anticipated to impact human communities, human health, or any historical, cultural, or archaeological site. Economic activities

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will be positively impacted by the facility. The project is not expected to result in environmental impacts which would serve as an economic burden to the local and regional economy.

5.35 Human Communities: Operation is not anticipated to significantly affect population, labor, or housing trends in the region. Existing fire and emergency medical facilities and fire fighting and police services will be capable of handling situations at the facility. The number of workers will not significantly affect traffic volume or contribute to a reduction in existing levels of service. Demands upon municipal services will be minimal.

5.36 Economic Activities: Operation could have significant positive direct impacts associated with the creation of jobs and the contribution to the local tax base. The project represents a significant direct investment of $300 million by AES. The project's environmental impact study estimated that the total impact to the local region could be twice that amount. In addition, there could be significant indirect impacts

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from the creation of jobs associated with industries that would use the electric power generated.

5.37 Public Health: Because the facility's emissions/effluents will meet applicable Brazilian standards and World Bank guidelines for surface water, groundwater, air, and noise, operation of the facility is not expected to impact public health.

5.38 Historical, Cultural and Archaeological Heritage Sites: Operation will not impact any historical, cultural, or archaeological site or Indian Territory.

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VI. MITIGATION AND MONITORING

6.1 The following sections discuss proposed mitigation and monitoring for potential construction and operational environmental and social impacts. Table 3 summarizes the potential impacts from construction and operation and proposed mitigation measures for these impacts.

A. Mitigation of Construction Impacts

6.2 Air Quality: The majority of earthmoving, cut and fill, and grading will be limited to the first four months of construction. Paving or the addition of gravel to graded working or parking areas and landscaping and seeding of surrounding berms or buffer areas will control incidental wind erosion of particulate materials. Unpaved roadways and earth surfaces will be watered to control fugitive dust from vehicle and equipment traffic. Onsite vehicles will be cleaned to minimize transport and mobilization of fugitive particles. To minimize diesel emissions, construction equipment will be

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maintained in good condition and will be turned off when not in use. Paints and solvents will be stored, handled, and used in compliance with applicable requirements and Best Management Practices.

6.3 Noise: Onsite personnel will be equipped with appropriate hearing protection to limit exposure and to comply with worker health and safety requirements. No blasting is anticipated. In addition, site traffic and other construction activities will be limited to daylight hours.

6.4 Soils: Best management practices will be used for erosion and sedimentation control. Erosion will be minimized by beginning cleanup and revegetation as soon as possible after construction activities. Other measures to be used include perimeter silt fencing, designation of restricted corridors for use by heavy vehicles during very wet or dry periods, implementation of dust abatement practices as needed, construction of sedimentation basins along any runoff interception and/or discharge channels, and stabilization of any such channels. Dewatering, if necessary, will be accomplished by pumping and discharge to a nearby storm water drainage ditch.

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6.5 Water Resources: Best management practices will be used to control the peak flow of storm water runoff, minimize the potential for the contamination of storm water runoff, minimize soil erosion, and control sediment loading in storm water runoff. Site grading and materials stockpiling will be performed using techniques to minimize erosion. Where appropriate, hay bales and/or silt fencing will be installed in areas down gradient of construction to limit sediment loadings in runoff. Sediment basins will be constructed, as required, to remove sediment and reduce peak flow discharges. Dewatering discharges will be routed to a settling basin to remove suspended solids prior to offsite discharge. Discharge from the settling basin will be visually inspected on a weekly basis to ensure sufficient solids removal. Regular visual inspections of the storm water pollution prevention system and of the storm water runoff from the site will be implemented to ensure that impacts to local surface waters will not be significant.

6.6 Specific staging areas will be established for the storage of construction vehicles, construction materials, and any fuels or chemicals to be used during construction.

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Measures will be taken to limit the exposure of construction-related raw materials, fuels, and chemicals to precipitation. Covered storage areas and/or secondary containment will be provided where appropriate.

6.7 Sanitary wastewater either will be collected and shipped for offsite treatment or be treated onsite using a package wastewater treatment plant. If a package wastewater treatment plant is used, discharges will be monitored monthly to ensure that compliance with Brazilian effluent limits and World Bank effluent guidelines (Table 2c). Treatment of the wastewater will also ensure that the infiltration of the treated wastewater will not significantly impact the groundwater.

6.8 Pollution prevention and best management practices will be used to minimize the potential for spills and/or releases to groundwater. Establishment of specific staging areas will limit the number of materials storage areas and allow for improved monitoring of potential release. Storage of materials in covered areas and/or areas equipped with impermeable secondary containment will further limit potential releases.

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6.9 Biological Resources: Site disturbance will be minimized and rapid revegetation will be encouraged after completion of construction. Temporary erosion and sediment control measures will be installed to control runoff and to minimize erosion of disturbed surface areas.

6.10 Human Communities: The construction contractor will make every effort to include local labor by seeking the participation of local construction companies with trained labor. Temporary housing will be located outside the Uruguaiana urban area, within approximately 2 km of the project site, and away from existing settlements. The housing complex will be self-sufficient and equipped with the amenities (such as sanitary facilities, recreation areas, phone services, cooking facilities, and food services) necessary for the well-being of the workers without their need to leave the complex. Workers will be transported to and from the project site by buses supplied by the construction contractor. Drivers of transport vehicles will be instructed to adhere to speed limits and other rules of the road to reduce the likelihood of accidents.

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6.11 Site development will incorporate a vegetative buffer that will be maintained around the proposed facility.

6.12 Public Health: The housing arrangement for the construction workers will reduce the level of interaction and the potential for undesirable effects associated with their presence in the local area and the region. Traffic routes have been planned to avoid the main urban center. During the peak construction period, truck deliveries will be spaced over an 8 to 10-hour period to minimize disruption to local transportation.

B. Mitigation of Operational Impacts

6.13 Air Quality: Dry low NO_x combustors will be used when firing natural gas. Natural gas will be used as the Best Available Control Technology (BACT) to minimize SO_2 emissions; during emergencies, low sulfur distillate oil will be used. Particulates will be controlled by the use of the low ash fuels. Drift eliminators will be used to control particulate emissions from the cooling tower. CO formation will be limited by

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providing adequate fuel residence time and high temperature in the combustion turbines to ensure complete combustion. VOC formation from the fuel will be controlled by good combustion controls. A fixed roof type tank will be used for the storage of distillate fuel oil. All air pollutant emissions from the proposed facility will comply with Brazilian and World Bank limits (Table 2a).

6.14 Noise: Basic plant design will ensure that noise levels at the site boundaries meet Brazilian and World Bank limits (Table 2d). Various controls, including gas turbine enclosures and the use of air silencers on the gas turbine inlets, will be implemented to reduce noise levels. After the plant has been operational for three months, a noise survey will be conducted (see Section 6.C for details).

6.15 Water Resources: Discharges from areas in which oil is stored/handled and storm water from the oil storage tank containment area will be routed through an oil/water separator prior to discharge.

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6.16 The brine from the reverse osmosis system and blowdown from the boilers will be routed for use in the cooling tower. The cooling water blowdown will undergo water softening prior to being routed to the facility's large wastewater tank. Mixed bed regenerant wastewater will be routed directly to this surge tank. The combined effluent will be pumped from the wastewater surge tank and routed to the Rio Uruguai. The combined discharge from the facility will comply with Brazilian effluent limits and World Bank guidelines (Table 2c), including specifically the guidelines for temperature.

6.17 The storm water drainage system will be designed to minimize soil erosion and control peak discharges of storm water. If required, the system will include one or more storm water detention basins. The system will be inspected on a regular basis and maintained to ensure proper operation.

6.18 The subsurface sewage disposal system will be constructed to comply with Brazilian standards and will supply sufficient treatment to ensure that shallow groundwater is

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not significantly impacted. If a package wastewater plant is used, discharges will be monitored on a monthly basis.

6.19 Onsite storage and handling of fuel oil, chemicals, and raw materials will be performed in a manner that will minimize spills and/or releases to the groundwater. To the extent practicable, materials will be stored indoors or within impermeable secondary containment to minimize releases to the shallow groundwater.

6.20 Soils: Facility design will include necessary surface drainage systems to channel roof and paved surface runoff into infiltration basins and other water infiltration and dispersion features. These features will be properly maintained by periodic cleaning of grates and removal of sediment accumulation in infiltration basins.

6.21 Biological Resources: The vegetation of non-constructed areas will be protected by restricting vehicular access to areas outside of parking areas and driveways. Any construction areas not permanently altered by buildings, utilities, etc. will be seeded and revegetated with native grasses and shrubs. The site will be landscaped with

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native grasses, trees, and shrubs. In addition, native plants will be used to screen the facility from nearby uses. The presence of native plants and an onsite storm water detention pond may provide habitat for wildlife species.

6.22 The water discharge structure in the Rio Uruguai will be designed to provide sufficient dispersion to ensure that the temperature rise criteria of the receiving water is met and that Brazilian Class 2 quality of the receiving water is maintained. Compliance with Brazilian regulations and World Bank guidelines should help to ensure that the facility's wastewater discharges will have no significant impact on the aquatic environment.

C. Proposed Monitoring Activities

6.23 Air Quality: During routine plant operation, continuous emissions monitoring will be conducted for stack opacity (particulate matter), NO_x, and CO emissions and flue gas oxiygen levels. Standard techniques, equipment, quality assurance and quality control methods such as those specified by the US EPA will be used.

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6.24 Noise: After the plant has been operational for three months, a noise survey will be conducted to define the noise levels at the property boundary with the plant running at full load. Noise levels at the major point sources will be measured at the same time and will be used as the basis for future monitoring of facility compliance.

6.25 In subsequent years, noise measurements will be taken annually for all major onsite noise sources. Annual noise surveys at the site boundary will also be conducted. In the event that equipment is replaced, noise levels will be measured after the equipment has been operational for one month. In all cases, standard techniques, equipment quality assurance and quality control methods will be used.

6.26 Soils: The effectiveness of construction phase storm water management and erosion/sediment control measures will be evaluated on a regular basis using visual inspections of the structural components and storm water runoff flows. Particular emphasis will be placed on performing visual inspections during and immediately after significant storm events. The site storm water drainage system used during operation

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will be visually inspected on a regular basis and will be maintained to ensure proper operation.

6.27 Water Resources: Prior to and during plant construction, surface water resources potentially affected by the proposed construction and operation of the power plant will be characterized using existing data from the Rio Uruguai. Water quality data for the Arroio do Imbaa do not exist and will be collected as part of a quarterly pre-operational water quality monitoring program. The parameters to be sampled will include temperature, pH, oil and grease, fecal and total coliform, BOD, COD, dissolved oxygen, turbidity, metals, volatile and semi-volatile organic compounds, pesticides, PCBs, and several common ions.

6.28 Two monitoring points will be established for the plant effluent. An in-plant continuous pH monitoring point will be established at the discharge from the demineralization system neutralization tank. The combined facility discharge will also be monitored continuously for flow, temperature and pH. The combined facility

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discharge will be monitored on a monthly basis for pH, oil and grease, BOD, metals, sulfate, phosphate, phenols, and residual chlorine.

6.29 Sanitary wastewater discharges during construction will be monitored on a monthly basis for pH, BOD_5, COD, TSS, and oil and grease. Regular visual inspections of the structural components of the construction phase stormwater pollution prevention system and regular visual examination of the stormwater runoff from the site will be implemented to ensure that impacts to local surface waters will not be significant.

6.30 During the operational phase, the discharge from the sanitary treatment system will be monitored monthly for pH, BOD_5, COD, total suspended solids, and oil and grease.

6.31 Groundwater monitoring will include water level monitoring and water quality monitoring. A plan will be developed to monitor groundwater levels using either existing and/or new wells screened across the basalt and sandstone formations. Groundwater level monitoring will be performed on a quarterly basis in the period

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Federal Decree No. 84.017	Created conservation areas denoted as Parks which are currently designated as Conservation Units.
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prior to and during site construction. A similar quarterly program of water level measurements will be conducted during the first year of plant operation. If no significant drawdown is observed, water level monitoring will be performed biannually thereafter.

6.32 Groundwater quality in the onsite water supply wells will be monitored on a quarterly basis during the period prior to and during plant construction. Groundwater routed to the power plant will be monitored continuously for temperature, conductivity, pH, and turbidity. During the first year of operation, groundwater quality will also be monitored on a quarterly basis for additional parameters including alkalinity, hardness, common ions, total suspended solids, and total dissolved solids. Assuming water quality remains in an acceptable range for use in the plant cooling towers, the quarterly sampling program will be downgraded to a biannual program thereafter.

D. Environmental and Social Management Plan

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6.33 AES will developed an Environmental and Social Management Plan for the proposed project (see Table 4 for outline) in order to ensure, monitor, and demonstrate compliance with environmental and social mitigation measures and standards during construction and operation of the facility. The Plan reflects AES management philosophy as well as environmental issues for the Uruguaiana plant.

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VII. RISK ASSESSMENT

7.1 The primary hazards associated with this facility are thermal radiation hazards and hazards from explosions. Thermal radiation hazards could result from jet fires caused by ignition of a pressurized discharge of natural gas from a break in piping, or tank fires caused by the ignition of lubricating or backup fuel oil in storage. The hazards from explosions are over pressure (i.e., blast waves) and fragments. These could result from confined explosions due to natural gas leaks within enclosed spaces, boiling liquid expanding vapor explosions (BLEVEs) produced as a result of steam drum failures, or confined explosions due to releases of hydrogen in enclosed spaces. With the exception of jet fires, none of these hazards would have offsite consequences.

7.2 The following systems could be the principal sources of a potential accident, although the risk of these occurring has a low probability: natural gas feed system, gas turbine system, steam production system, backup fuel/lubricating oil storage, electrical

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system, water treatment system, and generator hydrogen cooling system. Of the events listed above, the most likely to occur are: release and ignition of mineral oil from transformers, leading to a pool fire in the diked area; and spill and interaction of water treatment chemicals, sulfuric acid and sodium hypochlorite, which could release toxic chlorine gas.

7.3 The proposed facility design includes numerous measures intended to minimize risks. A detailed emergency response plan will be prepared and used as the basis for training personnel to respond to onsite emergencies. The following design features will be used to control risks.

7.4 Natural Gas System. The following risk mitigation measures are included in the plant design.

- Quick-closing emergency shutdown valves at regular intervals along the natural gas line feeding the combustion turbine to minimize confined explosion consequences.

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- A dual control system (both pressure and flow sensors) for the emergency shutdown valves.

7.5 Gas Turbine System. The following risk mitigation measures are included in the plant design.

- Appropriate blade design and tuning out of critical resonance at operating speed to minimize blade breakup.
- Use of pre-ventilation to purge the combustor and the entire gas path before the ignition is complete.
- Regular maintenance and repair.
- Use of thermocouples in thrust-bearing pads, set to alarm and trip at specified temperatures to minimize thrust-bearing failures.
- Protective devices such as overspend trip mechanisms and vibration instrumentation for tripping on high vibration for all bearings.
- Turbine exhaust temperature monitoring for tripping at high temperature.
- Two independent fire suppression systems for the combustion turbine.

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- Vibration alarms and automatic shutdown.
- Heavy-duty lube oil lines with flanged fittings.
- Use of fire resistive lubrication oil, and a shield for the hot exhaust duct to lower the surface temperature.
- Installation of a filter on the natural gas line to prevent dirty gas from causing an imbalance on the turbine blades.

7.6 Steam Production System. The following risk mitigation measures are included in the plant design.

- Steam drum pressure and low water alarms.
- Pressure control, temperature control, and water level control on the steam drum.
- Feedwater treatment to minimize corrosion.
- Multiple pressure relief valves.

7.7 Backup Fuel Storage System. The following risk mitigation measures are included in the plant design.

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- Temperature sensing devices on internal tank heaters used to maintain oil pumpability.
- Monitoring of the tank filling operation to prevent overfilling.
- Training of personnel involved in oil unloading operations.
- Ensure pump installations are located within tank dikes.
- Fire suppression equipment.
- Level control systems.
- Tank containment dikes equal to the volume of the tank plus the maximum design 24-hour rainfall plus 12 inches of freeboard.
- A fire safety shutoff valve in the liquid fuel supply pipingto the combustion turbines to isolate the liquid fuel storage tanks.

7.8 Lubricating Oil System. Monitoring devices will be provided to monitor lube oil temperature.

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7.9 Electrical System Transformers will be equipped with a fire suppression system and the transformers will be separated to minimize the risk of a multiple-transformer event.

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Resolution No. 1 (January 23, 1986)	Requires the completion of an environmental impact study (EIS) and subsequent environmental impact report (RIMA) for many activities, including any primary

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	energy source with a capacity in excess of 10 MW and electric power lines with capacities exceeding 230 kV. Provides a scope for the RIMA.
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Federal Decree No. 5.484 (June 27, 1928), Federal Decree No. 736 (April 6, 1936), Law No. 6.001 (December 19, 1973), and Federal Decree No. 94.946 (September 23, 1987)	Defined and created areas considered as Indian Territories for the protection of indigenous peoples. These territories also may be currently designated as Conservation Units and protected from development.
Portaria MME No. 2010 (December 26, 1979)	Sets the norms for authorization and licensing of operations which provide electricity to consumers.

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FACILITY OPERATION	
Air Emissions	
CONAMA Resolution No. 5 (June 15, 1989)	Proposes state-level permitting requirements for any facilities with air emissions.
CONAMA Resolution No. 3 (June 28, 1990)	Establishes concentration limits for air pollutants differentiating between Primary Standards (those with potentially adverse health effects if exceeded) and Secondary Standards (those which if not exceeded present a minimum adverse effect to the welfare of the population and environment in general).
CONAMA Resolution No. 8 (December 6, 1990)	Regulates the maximum emissions limits for total particulate matter and sulfur dioxide at facilities with external combustion processes which received their preliminary licenses after December 6, 1990.
Portaria MINTER No. 0231 (April 27, 1976)	Establishes air emissions discharge concentration limits.
Water Resource Use and Wastewater Quality	
SEMA Regulation No. 002 (February 9, 1989)	Establishes water use restrictions and requirements for facilities that divert federal public waters for industrial use.

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CONAMA Resolution No. 20 (June 18, 1986)	Establishes water quality limits and/or conditions for 9 classes of fresh, brackish and salt water. The discharging facility must determine the compatibility of its wastewater discharge with the receiving water limits and/or conditions. If the discharge has the potential to adversely impact the receiving water, the facility must also notify the state regulatory agency of the volume and type of effluent, the pollution control equipment in use, and the emergency action plans to prevent or mitigate accidental releases. The facility must also ensure that no pollutants are discharged to groundwater resources.
Regulatory Norm 24 (NR 24)	Requires that drinking water be provided to the facility by the local municipal water authority or that if such service is not available, that drinking water be obtained from a licensed provider and delivered in sealed containers.
Noise	
Resolution No. 1 (March 8, 1990)	Requires that the facility maintain exterior noise levels within those established in NBR 10151 (Evaluation of Noise in Inhabited Areas with a View Toward the Comfort of the community, prepared by the Brazilian Technical Standards Association).
Combustible and Flammable Liquid Storage	

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Regulatory Norm 20 (NR 20) (June 8, 1978)	Establishes the minimum fire safety requirements that must be incorporated into the design and construction of above and below ground storage tanks for flammable and combustible liquids.
Regulation GM No. 124 (August 20, 1980)	Requires the inclusion of spill control measures to prevent releases to water resources.
Solid and Hazardous Waste Generation and Disposal	
CONAMA Resolution No. 6 (June 15, 1988)	Requires that any facility which employs more than 500 people, uses a wastewater processing system, or generates dangerous wastes as defined by the competent environmental agency, submit information on the generation, characteristics, and final disposition of its wastes to the state environmental protection agency.
Regulation No. 053 (March 1, 1979)	Establishes requirements for the proper treatment or processing of hazardous solid waste. Requires that any temporary storage of any type of waste in an approved location which does not pose a risk to human health or the environment in the opinion of environmental and public health authorities.
Brazilian Association of Technical Norms Document NB-1183 (November 1988)	Requires that the facility store hazardous waste in a manner which protects the environment and community as addressed in the facility's operating license.

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CONAMA Resolution No. 9 (August 31, 1993)	Requires the submittal of a plan to the state environmental agency for the reduction in generation of used oil. Requires the maintenance of purchase and disposal records if the facility uses more than 700 liters per year. Biodegradable oils are excluded from this regulation.

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Table 2a
Comparison of the Uruguaiana Thermoelectric Power Project
with Brazilian Air Emission Limits and World Bank Air Emissions Guidelines

Pollutant	***Uruguaiana Project***	***Brazil***[1]	***World Ban***
Particulate Matter	4.3 mg/Nm^3 (gas) #50 mg/Nm^3 (fuel oil)	120 g/MMkcal (fuel oil)	50 mg/Nm^3 Alternatively, 99.9% if 50 m

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Table 2a
Comparison of the Uruguaiana Thermoelectric Power Project
with Brazilian Air Emission Limits and World Bank Air Emissions Guidelines

Pollutant	***Uruguaiana Project***	***Brazil***[1]	***World Ban***
			operated at lea Special condit airshed with n

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Pollutant	***Uruguaiana Project***	***Brazil***[1]	***World Ban***
			plants in air sh subject to site include offset is no net incre

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with Brazilian Air Emission Limits and World Bank Air Emissions Guidelines

Pollutant	***Uruguaiana Project***	***Brazil***[1]	***World Ban***
			particulates ar
Sulfur Dioxide	3 mg/Nm^3 (gas)	2000 g/MMkcal (fuel oil & coal)	2000 mg/Nm^3

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Pollutant	***Uruguaiana Project***	***Brazil***[1]	***World Ban***
	280 mg/Nm^3 (fuel oil)		0.20 tpd/MW tpd/MWe ove

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Pollutant	***Uruguaiana Project***	***Brazil***[1]	***World Ban***
			Maximum dai Special condit airshed with n

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Pollutant	***Uruguaiana Project***	***Brazil***[1]	***World Ban***
			particulates ar
Opacity	N/A	20% maximum, or Ringlemann	N/A

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Pollutant	***Uruguaiana Project***	***Brazil***[1]	***World Ban***
		No. 1	
Nitrogen Oxides			

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Pollutant	***Uruguaiana Project***	***Brazil***[1]	***World Ban***
Gaseous Fuels		Set by State Agency	320 mg/Nm^3 (
Gas Turbine / Combined Cycle	103 mg/Nm^3, dry @ 15% O_2		125 mg/Nm^3,
Liquid Fuels		Set by State Agency	460 mg/Nm^3 (

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Pollutant	***Uruguaiana Project***	***Brazil***[1]	***World Ban***
Gas Turbine / Combined Cycle	154 mg/Nm^3, dry @ 15% O_2		165 mg/Nm^3, 300 mg/Nm^3,

[1]Based on limits for new stationary sources >70 MW as established in CONAMA Resolution No. 8 of December 6, 1990.

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with Brazilian Air Emission Limits and World Bank Air Emissions Guidelines

Pollutant	***Uruguaiana Project***	***Brazil***[1]	***World Ban***
Only applies to installations in Class II and III areas; installation of new sources are not allowed in a Class I area. No limits are established for sources fueled by natural gas, or for emissions of NO_x - these must be established by the State Regulator			

[2]Based on World Bank Group's *Pollution and Abatement Handbook - Part III: Thermal Power Guidelines for New Plants*, Septem

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Pollutant	***Uruguaiana Project***	***Brazil***[1]	***World Ban***

Nm^3 is measured at 0^oC and 1 atm. Total mass emissions are in metric tonnes per day. All of the maximum emission levels should b time the plant or unit is operating, averaged annually.

Assumptions - Oil: flue gas dry 3% excess O_2, assumes 280 Nm^3/GJ
Natural Gas: flue gas dry 3% excess O_2, assumes 270 Nm^3/GJ

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Table 2b
Comparison of the Uruguaiana Thermoelectric Power Project
with Brazilian Air Quality Standards and World Bank Ambient Air Quality Guidelines

Pollutant	***Uruguaiana Project***[1]	***Brazil***[2]	***World Ban***
Particulate Matter			
Annual Average	15.3 Fg/m^3 TSP (Natural gas)	80 Fg/m^3 TSP (primary) 60 Fg/m^3 TSP (secondary)	50 Fg/m^3 PM

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24-Hour Average	Unknown for natural gas. 46.1 Fg/m^3 TSP (No.2 oil)	240 Fg/m^3 TSP (primary) 150 Fg/m^3 TSP (secondary) (Note: Cannot exceed more than once a year)	150 Fg/m^3 PM
Sulfur Dioxide			
Annual Average	10.8 Fg/m^3 (Natural gas)	80 Fg/m^3 (primary) 40 Fg/m^3 (secondary)	80 Fg/m^3
24-Hour Average	Unknown for natural gas.	365 Fg/m^3 (primary)	150 Fg/m^3

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	36.2 Fg/m^3 (No. 2 oil)	100 Fg/m^3 (secondary) (Note: Cannot exceed more than once a year)	
Nitrogen Oxides			
Annual Average	6.8 Fg/m^3	100 Fg/m^3 (primary & secondary)	100 Fg/m^3
24-Hour Average	20.8 Fg/m^3	N/A	150 Fg/m^3

Table 2b

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Comparison of the Uruguaiana Thermoelectric Power Project
with Brazilian Air Quality Standards and World Bank Ambient Air Quality Guidelines

Pollutant	***Uruguaiana Project***[1]	***Brazil***[2]	***World Ban***
1-Hour Average	94.1 Fg/m^3	320 Fg/m^3 (primary) 190 Fg/m^3 (secondary)	400 Fg/m^3
Carbon Monoxide			

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8-Hour Average	Unknown	10 mg/m^3 or 9 p.m. (primary & secondary) (Note: Cannot exceed more than once a year)	N/A
1-Hour Average	Unknown	40 mg/m^3 or 35 p.m. (primary & secondary) (Note: Cannot exceed more than once a year)	N/A

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Ozone			
1-Hour Average	Unknown	160 Fg/m^3 (primary & secondary) Note: Cannot exceed more than once a year	N/A

Table 2b
Comparison of the Uruguaiana Thermoelectric Power Project

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with Brazilian Air Quality Standards and World Bank Ambient Air Quality Guidelines

[1]Estimated total impact of Uruguaiana Project, includes background concentration + estimated plant impact. provided in Section V of this report .

[2]Based on CONAMA Resolution No. 3 of June 28, 1990.
Reference conditions are set at a temperature of 25^{o}C and pressure of 760 millimeters of a column of mercu
Primary standards - if exceeded may affect human health.
Secondary standards - if not exceeded, have a minimum adverse effect on the welfare of the population and

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to flora, fauna, materials and the environment.

[3]Based on World Bank Group's *Pollution Prevention and Abatement Handbook - Part III*, September 1, 19
"Airborne Particulate Matter," "Sulfur Oxides," "Nitrogen Oxides," and "Ground-Level Ozone".

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Table 2c
Comparison of the Uruguaiana Thermoelectric Power Project
with Brazilian and Argentinean Effluent Limits and World Bank Liquid Effluent Guidelines

Pollutant	***Uruguaiana Project***	***Brazil[1]***	***Argentina[2]***	
pH	8.6	5 to 9	6.5 to 10	6
Heavy Metals Chromium (total)	N/A	N/A	#0.5 mg/l	0

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Chromium (hexavalent)	0.07 mg/l	0.5 mg/l	N/A	N
Copper	0.02 mg/l	1.0 mg/l	#0.1 mg/l	(
Iron	7.0 mg/l	15.0 mg/l (soluble)	#2.0 mg/l (soluble)	1
Nickel	N/A	2.0 mg/l	#2.0 mg/l	N
Zinc	2.1 mg/l	5.0 mg/l	#2.0 mg/l	1
Oil & Grease	10 mg/l	20 mg/l	N/A	1
Total Suspended Solids	Unknown; however, should be minimal	1 ml/l - 1 hour Imhoff cone test	N/A	5
Residual chlorine	0.17 mg/l	N/A	N/A	(

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Temperature increase [edge of mixing zone]	35^{o}C; <3^{o}C above ambient temperature of receiving waters	3^{o}C increase in receiving water body; <40^{o}C maximum	#45^{o}C	

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Table 2c
Comparison of the Uruguaiana Thermoelectric Power Project
with Brazilian and Argentinean Effluent Limits and World Bank Liquid Effluent Guidelines

[1]Based on standards listed in Article 21 of CONAMA Resolution No. 20 of June 18, 1986. Discharges also cannot cause applicable receiving waters to be exceeded. (Brazil has established 9 different classifications/standards of water quality for fresh, salt and brack

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[2]Based on Argentinean Decrees Nb. 674/89 and 776/92.

[3]World Bank Group's *Pollution and Abatement Handbook - Part III: Thermal Power Guidelines for New Plants*, September 1, 199

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Table 2d
Comparison of the Uruguaiana Thermoelectric Power Project
with Brazilian Noise Limits and World Bank Noise Guidelines

Location	***Uruguaiana Project***	***BRAZIL[1]***	**V**
Ambient dBA (day/night)	58 dBA at northeast corner of project site 64 dBA immediately south of southeast corner of project site	Non-urban Residential & Hospital Zones 45/40 db(A) Urban Residential Zone 55/50 db(A)	F F

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		City Center (business, commerce, administration) 65/55 db(A) Predominantly Industrial 70/65 db(A)	I A n

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[1]Based on CONAMA Resolution No. 1 of March 8, 1990 and NBR 10151 "Evaluation of Noise in Inhabited Areas with a View Tow

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[2]World Bank Group's *Pollution and Abatement Handbook - Part III: Thermal Power Guidelines for New Plants*, September 1, 199

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Table 3
Summary of Potential Impacts and Mitigation
Uruguaiana Gas Thermoelectric Power Plant

POTENTIAL IMPACTS	MITIGATION
AIR QUALITY ! Fugitive particulates from earthwork and vehicle traffic, and wind erosion of exposed surfaces ! Emissions from operations of vehicles, heavy equipment, and other engine-powered equipment ! Emissions from paint and cleaning solvents, asphalt operations, and onsite oil storage tank ! Emissions of NO_2, SO_2, PM, PM_{10}, CO, and VOC	! Limit majority of earthwork to first four months of construction ! Pave or add gravel to graded working or parking areas ! Landscape and seed beams and/or buffer areas ! Water unpaved roads and earth surfaces ! Clean onsite vehicles to minimize transport and mobilization of fugitive particulates ! Maintain construction equipment and turn off when not in use ! Store, handle, and use paints and solvents according to Best Management Practices ! Use dry low NO_x combustors ! Use natural gas or low sulfur distillate oil to control SO_2 ! Use low ash fuels and drift eliminators to control particulates ! Use good combustion controls to control CO and VOC ! Install fixed roof type tank for storage of distillate fuel oil

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	! Use continuous emissions monitoring for NO_x, stack opacity (PM), and CO
NOISE ! During construction, noise will vary, but is predicted to only exceed ambient sound levels during ground clearing ! During operation, potential impacts to offsite residences, schools, etc.	! Equip onsite personnel with appropriate hearing protection ! Blast only during daylight hours ! Design plant to meet Brazilian and World Bank limits at site boundaries ! Use gas turbine enclosures and air silencers on gas turbine inlets ! Perform noise monitoring at full load after 3 months of operation ! Annually measure all major sources of onsite noise ! When equipment replaced, measure noise level after one month of operation ! Annually survey noise at site boundary
GEOLOGY AND GEOMORPHOLOGY	! Use soil erosion measures to control exposure of geologic

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POTENTIAL IMPACTS	MITIGATION
! Removal of unconsolidated rock and earth	materials
SOILS ! Loss of excavated soil due to water and wind erosion ! Reduction of soil quality from mixing topsoil with subsoil ! Soil compaction by construction equipment ! Temporary alteration of natural drainage patterns ! Loss of soil due to Storm water runoff from impervious surfaces and other structural features	! Implement Best Management Practices for erosion and sedimentation control ! Begin cleanup, seeding, and revegetation of construction areas as soon as possible after construction activities ! Use perimeter silt fencing, and designate restricted corridors for use by heavy vehicles ! Implement dust abatement practices ! Construct sedimentation basins along any runoff interception and/or discharge channels, and stabilize such channels ! Accomplish dewatering by pumping and discharge to Storm water drainage ditch ! Construct surface drainage systems to channel roof and paved surface runoff into infiltration basins and other water infiltration and dispersion features; maintain by periodic cleaning of grates and removal of sediment

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POTENTIAL IMPACTS	MITIGATION
	! Restrict vehicular access to areas outside of parking areas and driveways
WATER RESOURCES ! Contamination of surface waters by discharges of sediment and/or contaminated Storm water runoff, construction dewatering discharges, and sanitary waste discharges ! Contamination of groundwater by infiltration of sanitary wastewater discharges or by spills of construction-related chemicals ! Potential impacts due to water withdrawal, and treatment and use of that water	! Use Best Management Practices to design Storm water drainage system to control peak runoff flow, minimize soil erosion, minimize contamination of runoff, and control sediment loading in runoff ! Use site grading and materials stockpiling techniques to minimize erosion ! Install hay bales and/or silt fencing in areas down gradient from construction ! Construct and visually inspect weekly sedimentation basins to ensure sufficient solids removal ! Route dewatering discharges to settling basin prior to offsite discharge ! Regularly visually inspect Storm water pollution prevention system and Storm water runoff from site ! Establish specific staging areas for storage of

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POTENTIAL IMPACTS	MITIGATION
	construction vehicles, fuels, and chemicals ! Limit exposure of construction raw materials, fuels, and chemicals to precipitation ! Provide covered storage areas and/or impermeable secondary containment for oils, chemicals, and raw materials
WATER RESOURCES (cont.)	! During construction, ship sanitary wastewater for offsite treatment or treat using package wastewater treatment plant ! Implement groundwater monitoring prior to construction and continue on quarterly basis for first year of operation and on a biannual basis thereafter ! Route discharges from oil storage/ handling areas and Storm water from oil storage tank containment area through oil/water separator ! Implement surface water monitoring plan on quarterly basis for first year of operation and on a biannual basis

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Summary of Potential Impacts and Mitigation
Uruguaiana Gas Thermoelectric Power Plant

POTENTIAL IMPACTS	MITIGATION
	thereafter ! Construct subsurface sewage disposal to comply with Brazilian standards and to supply sufficient treatment to not impact groundwater ! If package wastewater plant used, monitor discharges on monthly basis ! Perform onsite storage and handling of fuel oils, chemicals, and raw materials in a manner to minimize spills and/or releases to groundwater ! Comply with Brazilian effluent limits and World Bank guidelines for combined facility discharge, facility cooling systems, and other surface water discharges
BIOLOGICAL RESOURCES ! Removal of vegetation in construction area ! Potential displacement of animal species ! During construction, temporary increase in ambient noise levels and fugitive dust and vehicle emissions	! Minimize site disturbance and rapidly revegetate after construction ! Implement erosion and sediment control measures ! Comply with Brazilian effluent limits and World Bank guidelines for wastewater discharges to surface waters

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Summary of Potential Impacts and Mitigation
Uruguaiana Gas Thermoelectric Power Plant

POTENTIAL IMPACTS	MITIGATION
! Impact to aquatic organisms by pollutants in Storm water	
SOCIO-ECONOMIC CONDITIONS Human Communities ! During construction, short-term stress on socio-economic infrastructure due to influx of workers. (550 workers needed; about 70 percent from outside local area)	! Promote hiring of local construction companies with trained labor ! Provide self-sufficient, temporary housing for construction workers outside Uruguaiana urban area and within 2 km of project site and away from existing settlements ! Use buses to transport workers to project site; drivers will adhere to speed limits ! Treat routine medical services and minor injuries at work site or at housing complex ! House technical professionals in rental housing in Uruguaiana ! Buffer project site from residential developments and/or settlements
SOCIO-ECONOMIC CONDITIONS	! Short-term employment for up to 150 local laborers and

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POTENTIAL IMPACTS	MITIGATION
Economic Activities ! Influx of monetary resources and increased demand for private services ! Increased demand for construction materials and consumable goods ! Potential increased cost of living for local residents ! Creation of jobs and contribution to local tax base	specialized technicians
SOCIO-ECONOMIC CONDITIONS Public Health ! Increase in traffic ! Increase in air emissions ! Influx of non-local workers	! Facility's emissions/effluents will meet Brazilian standards and World Bank guidelines for surface water, air, and noise

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Table 4
Outline of Environmental and Social Management Plan
for
Uruguaiana Thermoelectric Power Plant

I. Overview

A. Project summary (owners, constructors, location, plant size, electricity sales, source of fuel, water supply, wastewater discharge, brief description of environmental mitigation measures).

II. Water Resources Monitoring Plan

A. Groundwater
   1. Source of facility water
   2. Description of facilities to be built to deliver water
   3. Description of proposed monitoring program
      a. Parameters to be measured
      b. Frequency of measurements

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c. Frequency of reporting
d. To whom reports are sent
e. Applicable regulations

B. Wastewater
1. Construction
a. Description of types of liquid effluents
b. How effluents will be disposed
c. Dewatering of groundwater
d. Mitigation measures used during discharge
2. Operation
a. Description of waste streams and their disposition
b. Description of proposed monitoring program
(1) Parameters to be measured
(2) Frequency of measurements
(3) Frequency of reporting
(4) To whom reports are sent
(5) Applicable regulations

Table 1
Summary of Regulations Reviewed for EIS

FACILITY SITE SELECTION AND CONSTRUCTION	
Environmental Impact Assessment	
Project Specific terms of Reference, IBAMA, August 1997	The Terms of Reference document outlines the content/requirements for the environmental impact assessment of the proposed project.
Decree No. 99.274 (June 6, 1990)	Contains general provisions for those projects which require environmental impact studies and licenses for activities having an environmental impact. Provides CONAMA, the federal environmental executive agency, with the authority to require special standards from facilities located within 10 kilometers of a designated Conservation Unit. Requires the issuance of a Preliminary License (LP), Installation License (LI), and Operating License (LO) for the respective stages of planning, construction, and operation of the facility.
Resolution No. 1 (January 23, 1986)	Requires the completion of an environmental impact study (EIS) and subsequent environmental impact report (RIMA) for many activities, including any primary energy source with a capacity in excess of 10 MW and electric power lines with capacities exceeding 230 kV. Provides a scope for the RIMA.
Federal Decree No. 84.017	Created conservation areas denoted as Parks which are currently designated as Conservation Units.
Federal Decree No. 89.336 (January 31, 1984)	Created conservation areas denoted as Ecologic Reserves which are currently designated as Conservation Units.
Law No. 4.771 (September 15, 1965)	Created conservation areas denoted as Permanent Preservation Areas which are currently designated as Conservation Units.
Federal Law No. 98.897 (January 30, 1990)	Created conservation areas denoted as Extractive Reserves which currently designated as Conservation Units.

C. Storm water Management
   1. Description of best management practices
   2. Inspection frequency
   3. Reporting

III. Air Monitoring Programs

A. Construction Phase
   1. Sources of emissions (fugitive dust, combustion emissions from construction equipment)
   2. Mitigation measures

B. Operational Phase
   1. Description of ambient monitoring performed in permitting phase
   2. Description of emissions control measures
   3. Summarization of impact modeling results
   4. Discussion of why there is no need for ambient air quality monitoring
   5. Plans for in-stack monitoring/parameters to be measured to ensure compliance with applicable emission limits

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6. Reporting frequency
7. To whom reports are sent
8. Applicable regulations

IV. Program for Monitoring Noise

A. Description of noise generating equipment during construction and operation
B. Mitigation measures
C. Plans for ambient measurements during operation
D. Reporting frequency

V. Hazardous and Non-Hazardous Solid Waste

A. Potential sources and disposition of hazardous waste
B. Sources and disposition of nonhazardous waste during construction
C. Sources and disposition of nonhazardous waste during operation
D. Mitigation measures to keep hazardous materials away from surface waters and ground waters
E. Recycling of certain materials

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VI. Socio-economic Environment

A. Social Responsibility Program
   1. Plans for worker housing and relaxation facilities when off duty
   2. Possible establishment of fund or contributions to existing fund for preservation of endangered species of flora and fauna in Rio Grande do Sul
   3. Possible contribution to fund for preservation of arroyos in Uruguaiana area

B. Regional Plan Integration
   1. Description of site selection process and site's integration with Master Plan

VII. Health and Safety

A. Description of establishment of management structure to ensure compliance with applicable health and safety regulations

B. Development of a pre operational plan to address construction related environmental and health and safety issues

C. Contractor to implement the plan during construction; clear line to responsibility to see that plan is adhered to

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D. Health and safety plan for operations to be developed during construction
E. Description of safety measures for handling fuels, fire prevention systems, alarms, etc.

VIII. Training

A. Construction and operation schedule
B. Description of the types of jobs required during construction and operation
C. Description of the source of labor
D. Description of training programs for workers, especially local labor. Sources and disposition of nonhazardous waste during construction

IX. Record Keeping

A. Description of data acquisition system
B. Description of maintenance of logs